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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

RAIZEN, DEBORAH A

ART UNIT	PAPER NUMBER
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2873

DATE MAILED: 10/15/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/759,806

Applicant(s)

SHAFER, DAVID R.

Examiner

Deborah A. Raizen

Art Unit

2873

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 8, 10, 11, 12, and 33 is/are allowed.
- 6) ☒ Claim(s) 1,2,4,6,7,9,13,14,17-19,21,23,25-32 and 34 is/are rejected.
- 7) ☒ Claim(s) 3,5,15,16,20,22 and 24 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 January 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4,6,un,7. 6) ☐ Other: _____

DETAILED ACTION

Priority

If applicant desires priority under 35 U.S.C. 119(e) based upon a previously filed copending application, specific reference to the earlier filed application must be made in the instant application. This should appear as the first sentence of the specification following the title, preferably as a separate paragraph.

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: M32 in Figure 3. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

The disclosure is objected to because of the following informalities:

There are typographical errors. (For example, p. 3, line 4)

The quantities listed in Table 1, pp. 7-10, are not labeled, defined, and provided with dimensions.

The following terms, which appear in the claims, should be defined:

planar folding mirror (in claims 1 and 10)

aperture plane (in claims 1, 10, and 25)

Art Unit: 2873

most imageward (does it mean physically or optically?) (in claims 1, 2, 10, 11, and 17)

unobscured pupil (in claims 4 and 12)

unobscured system aperture (in claims 10 and 11)

a straight axis of symmetry of all curvatures of all optical elements (in claims 4, 12, and 18)

deviate substantially from disk form (in claims 4 and 12)

substantially non-rotationally symmetric form (in claims 5 and 13)

negative reduction ratio (in claims 8 and 15)

positive reduction ratio (in claims 8 and 15)

any other terms that examiner has misinterpreted or that otherwise need clarification

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 6, 7, 9, 13, 18, 21, 23, 25, 26, 28, 31, and 32 are rejected under 35

U.S.C. 102(b) as being anticipated by Williamson (5,815,310). Williamson discloses (third embodiment, Fig. 3 and Table 3) a microlithographic reduction projection catadioptric objective having an image side (labeled “wafer”) and an object side (labeled “reticle”) and curved mirrors (M1-M6). The Williamson objective is devoid of planar folding mirrors. Also, the Williamson objective comprises an aperture plane on the image side of the most imageward curved mirror,

Art Unit: 2873

M6 ("aperture plane" is broadly interpreted to mean a plane in which an aperture stop may be inserted).

In regard to claim 6, Williamson discloses a microlithographic reduction projection catadioptric objective having an image side and an object side, consisting, in sequence from the object side to the image side, of a catadioptric group (R1-M4", objects 1-7 in Table 3), a catoptric group (mirrors M5" and M6"), and a dioptric group (lens R3). The catadioptric group provides a real intermediate image at plane 24", the catoptric group provides a virtual image (reflection of the beam off M5" provides a virtual image), and the dioptric group provides a real image at the wafer.

In regard to claim 7, Williamson discloses a microlithographic reduction projection catadioptric objective having an image side and an object side, having, in sequence from the object side to the image side, a field lens group (lens R1), a catadioptric group (M1"-M3") having one or more negative lenses (lens R2) and a concave mirror (M1" or M3"), generating axial chromatic aberration (col. 6, lines 58-62), a group having an odd number of curved mirrors (M4"-M6"), and a positive lens group (R3).

In regard to claim 9, Williamson discloses an objective having the features of claim 6, in which the catadioptric group has a positive field lens group (R1) and a negative lens group (R2) next to a mirror (M2"), and in which the dioptric lens group has more positive than negative lenses (R3 is positive).

In regard to claim 13, Williamson discloses a microlithographic reduction projection catadioptric objective having an image side and an object side, having more than two curved mirrors (6 mirrors M1"-M6") and no more than one optical element that is in a substantially non

Art Unit: 2873

rotationally symmetric form (col. 6, lines 14-16). Also, as explained above for claim 6, the Williamson objective consists of a catadioptric group providing a real intermediate image, a catoptric or catadioptric group providing a virtual image, and a dioptric group providing a real image.

In regard to claim 18, Williamson discloses an objective having the features of claim 1, which has a straight axis of symmetry of all curvatures of all optical elements (col. 6, lines 14-16).

In regard to claim 21, Williamson discloses an objective having the features of claim 1, in which all lenses built in as full disks do not obstruct a beam path (lenses R1-R3 do not obstruct the beam path). Also, as examiner assumes was intended for claim 21, all mirrors built in as full disks do not obstruct a beam path (mirrors M2'', M5'', and M6'' do not obstruct a beam path (Figure 3)).

In regard to claim 23, Williamson discloses an objective having the features of claim 18, in which the curved mirrors have optical surfaces that comprise sections or full surfaces of revolution (mirrors M1''-M6'' have such optical surfaces).

In regard to claim 25, Williamson discloses an objective having the features of claim 7, which has an aperture plane located within a catadioptric chromatic aberration generating group comprising at least one negative lens and a concave mirror: an aperture stop is located at or near mirror M2 (col. 2, lines 41-42 and Table 3); mirror M2 is located in a catadioptric group (M1''-M3''), which generates chromatic aberration (col. 6, lines 58-62) and has negative lens R2 and concave mirror M1'' or M3''.

In regard to claim 26, Williamson discloses an objective having the features of claim 1, which has a field lens group (R1) next to an object plane (labeled "reticle") and is object-side telecentric (col. 4, lines 21-23. The third embodiment is nearly identical to the second embodiment, differing only in the addition of three weakly refracting lenses and the slightly smaller aperture stop in the same location).

In regard to claims 28, 31, and 32, Williamson discloses an objective having the features of base claims 1, 6, and 7. Williamson discloses including such an objective in a projection exposure apparatus that has an excimer light source (col. 6, line 65), an illumination system (col. 1, line 16), a reticle handling, positioning and scanning system, and a wafer handling, positioning and scanning system (col. 2, lines 12-15).

Claims 2, 14, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by Takahashi et al. (5,835,275). Takahashi discloses a microlithographic reduction projection catadioptric objective having an object side (R) and an image side (W) and curved mirrors (M_C), wherein after a most imageward curved mirror (M_C) the beam diverges (the beam reflected from M_C passes through two negative lenses, which cause the beam to diverge).

In regard to claim 14, Takahashi discloses an objective having the features of base claim 2. The objective further has, in sequence from the object side to the image side, a field lens group (A_1), a catadioptric group (A_2) comprising one or more negative lenses (e.g. L_C) and a concave mirror (M_C), generating axial chromatic aberration (unless a lens group is carefully designed, and disclosed, not to generate axial chromatic aberration, a lens group inherently generates axial chromatic aberration), a group comprising an odd number of mirrors (group B,

Art Unit: 2873

comprising mirror M_2 ; mirror M_1 can be considered to be in group A_2 or in its own group), and a positive lens group (B_2).

In regard to claim 19, Takahashi discloses an objective having the features of base claim 2. The objective further has an intermediate image: a virtual image is formed by M_2 . Also, two mirrors are arranged upstream of the virtual image, in the path of the beam: mirrors M_1 and M_C .

Claims 4, 17, and 27 are rejected under 35 U.S.C. 102(b) as being anticipated by Sato et al. (4,757,354). Sato (in Figure 10, third embodiment) discloses a microlithographic reduction projection catadioptric objective having a system with an unobscured pupil (AP), which has a plurality of optical elements (elements 11-17) and a straight axis of symmetry of all curvatures of all optical elements (the common optical axis), wherein no more than two optical elements deviate substantially from disk form (only mirrors 16 and 17 deviate substantially from disk form).

In regard to claim 17, Sato discloses a microlithographic reduction projection catadioptric objective having an object side (19) and an image side (18), wherein a most imageward mirror is convex (mirror 17).

In regard to claim 27, Sato discloses an objective having the features of base claim 4. Furthermore, the Sato objective has the features recited in claim 27: all the lenses (11-14) are located within a cylindrical envelope of minimal radius (half the diameter of lens 14), and all but one of the curved mirrors is located within a same envelope (only mirror 16 is outside the envelope).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takahashi et al. (5,835,275) in view of Williamson (5,815,310). Takahashi discloses an objective having the features of base claim 2. Furthermore, Takahashi (5,835,275) discloses (in Fig. 5) including such an objective in a projection exposure apparatus that has a short-wavelength light source (col. 1, line 8), an illumination system (12 in Fig. 5, col. 7, line 4), a reticle handling (16 in Fig. 5), positioning (24 in Fig. 5) and scanning (col. 3, lines 28-34) system, and a wafer handling (22 in Fig. 5), positioning (26 in Fig. 5) and scanning system (col. 3, lines 28-34). However, Takahashi (5,835,275) does not disclose use of an excimer laser as the light source. Williamson discloses use of an excimer laser as a light source in a similar projection exposure apparatus (col. 6, line 65). Furthermore, excimer lasers are desirable for use in microlithography because they generate short-wavelength, high-powered, narrow-bandwidth (reduces chromatic aberration) light. It would have been obvious to one of ordinary skill in the art to use an excimer laser as the short-wavelength light source in the Takahashi projection exposure apparatus because, as taught by Williamson, excimer lasers are used in microlithography to generate narrow bandwidth light.

Claims 30 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (4,757,354) in view of Takahashi et al. (6,008,885). Sato discloses an objective that has the

Art Unit: 2873

features of base claims 4 and 17. Furthermore, Sato discloses use of such an objective in photolithography (col. 1, line 8) with deep-ultraviolet light (col. 11, line 12) and placing a wafer at the image plane (col. 10, line 50). However, Sato does not disclose including an excimer laser, an illumination system, a reticle handling, positioning and scanning system, and a wafer handling, positioning and scanning system in a photolithographic apparatus. Takahashi discloses including a projection optical system (col. 3, line 45) in a projection exposure apparatus that has an excimer light source (col. 3, line 66), an illumination system (col. 3, line 48), a reticle handling, positioning and scanning system, and a wafer handling, positioning and scanning system (col. 1, line 67 to col. 2, line 5). Furthermore, Takahashi teaches that the illumination system is desirable for illuminating a portion of a reticle (col. 1, line 6), and that the systems for handling, positioning and scanning the reticle and wafer are desirable for fine pattern printing with higher precision (col. 1, lines 20-22). Excimer lasers are desirable in microlithography because they generate short-wavelength, high-powered, narrow-bandwidth light. It would have been obvious to one of ordinary skill in the art to use an excimer laser as the deep-ultraviolet light source for the Sato objective because, as taught by Takahashi, excimer lasers are used in microlithography, and because excimer lasers generate light of suitable characteristics. Also, it would have been obvious to one of ordinary skill in the art to include an illumination system in a projection exposure apparatus having the Sato objective because, as taught by Takahashi, an illumination system is desirable for illuminating a portion of a reticle. Moreover, it would have been obvious to one of ordinary skill in the art to include systems for handling, positioning and scanning the reticle and wafer in a projection exposure apparatus having the Sato objective

Art Unit: 2873

because, as taught by Takahashi, such systems are desirable for fine pattern printing with higher precision.

Allowable Subject Matter

Claims 8, 10, 11, 12, and 33 are allowed.

The following is an examiner's statement of reasons for allowance:

For each claim, the preamble term "catadioptric" has been understood to mean that the claim has the limitation "having at least one mirror and at least one lens."

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 8, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 8. For example, Williamson discloses a microlithographic reduction projection catadioptric objective that has an image side and an object side and that has, in sequence from the object side to the image side, a catadioptric group (M1"-M3") having one curved mirror (M1", M2", or M3"), a group having an odd number of curved mirrors (M4"-M6"), and a dioptric lens group (R3). Furthermore, the dioptric group has a negative reduction ratio, as recited in claim 8. However, the catadioptric group does not have a negative reduction ratio (as understood—the beam does not converge after M3") and the group having an odd number of curved mirrors does not have a positive reduction ratio (as understood—the beam does not diverge after M6").

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 10, in such a manner that a rejection under 35 U.S.C. 102 or 103 would

Art Unit: 2873

be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 10. For example, Williamson discloses a microlithographic reduction projection catadioptric objective, having an object side and an image side, which is devoid of planar folding mirrors and has an aperture plane on the image side of a most imagedward curved mirror (as explained for claim 1 above). Furthermore, the Williamson objective has an unobscured system aperture and an even number greater than two of curved mirrors. However, the Williamson objective does not have more lenses than curved mirrors (it only has three lenses versus six curved mirrors).

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 11, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 12. For example, Takahashi discloses a microlithographic reduction projection catadioptric objective that has an object side and an image side, with an unobscured system aperture and including more lenses than curved mirrors, wherein after a most imagedward curved mirror the beam diverges (as explained for claim 2 above). However, the Takahashi objective does not have an even number greater than two of curved mirrors.

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 12, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 12. For example, Schuster (DE 19639586, family member of US 6,169,627) discloses a microlithographic reduction projection catadioptric objective that has an unobscured pupil and a straight axis of all curvatures of all optical elements, and in which no more than two optical

elements deviate substantially from disk form. Furthermore, the Schuster objective has more than 8 lenses. However, the Schuster objective does not have four curved mirrors (it has only two).

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 33, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 33. Claim 33 depends on allowed claim 8, and therefore has all the limitations of claim 8, whose combination is not taught by the prior art.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Claims 3, 5, 15, 16, 20, 22, and 24 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

For each claim, the preamble term "catadioptric" has been understood to mean that the claim has the limitation "having at least one mirror and at least one lens."

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 3, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in

Art Unit: 2873

claim 3. For example, Williamson discloses a microlithographic reduction projection catadioptric objective that has the features of base claim 1. Furthermore, the Williamson objective has four curved mirrors. However, the Williamson does not have more than eight lenses (it only has three).

Claims 5, 22, and 24 depend on allowed claim 3, and therefore have all the limitations of claim 3, whose combination is not taught by the prior art.

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 15, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 15. For example, Schuster discloses a microlithographic reduction projection catadioptric objective that has the features of base claim 4. Furthermore, the Schuster objective has an object side and an image side, and has, in sequence from the object side to the image side, a catadioptric group having one curved mirror (elements 1-21), a group having an odd number of curved mirrors (mirror 23), and a dioptric lens group (elements 25-60) having a negative reduction ratio. However, the catadioptric group does not have a negative reduction ratio (as understood—the beam does not converge after mirror 21), and the group with an odd number of curved mirrors does not have a positive reduction ratio (as understood—the beam does not diverge after mirror 23).

Claim 16 depends on claim 15, and therefore has all the limitations of claim 15, whose combination is not taught by the prior art.

The prior art taken either singularly or in combination fails to anticipate or fairly suggest the limitations of claim 20, in such a manner that a rejection under 35 U.S.C. 102 or 103 would

Art Unit: 2873

be proper. The prior art fails to teach a combination of all the claimed features as presented in claim 20. For example, Williamson discloses a microlithographic reduction projection catadioptric objective that has the features of base claim 6. However, the Williamson objective does not have an image side numerical aperture of $NA=0.7$ or greater (it only has $NA=0.6$, col. 6, line 20).

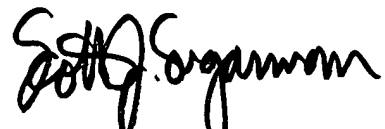
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Deborah A. Raizen, Art Unit 2873, whose telephone number is (703) 305-7940. The examiner can normally be reached on Monday-Friday, 8 a.m. to 4:30 p.m. Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Epps, can be reached on (703) 308-4883. The fax numbers of Technology Center 2800 are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

dar
October 7, 2002


Scott J. Sugarman
Primary Examiner